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Creating a Multifunctional Shear Strength Test Tool to Support Research and Learning at Semarang State Polytechnic Laboratory

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Abstract:- Mortar is a building material consisting of a mixture of cement: sand and water with different percentages. Shear force/strength is an important element of the mechanical properties of the mortar. The purpose of this research is to create a multifunctional shear strength test tool that helps to obtain the shear strength of various building materials, where the building materials are mortar and concrete, as well as wood used for molding/begesting. If the finished object, for example: paving, brick and hebel brick and others. In the trial process of the multifunctional shear strength test equipment/running multifunctional shear strength test equipment, the test objects are in the form of rectangular paving and hexagonal paving. Mortar Mixture 1 PC: 5 PS, in the form of rectangular paving material which is formed into a Test Sample with a total of 12 PC samples. And in implementation it failed so that the number of samples = 9 PCs. , from the results of the Test Execution, Shear Strength with the equation Y = - 0.1792 X2 + 5.5733 X + 2.0228 and its correlation R2 = 0.9779. And 1 PC Mortar mixture: 4PS + Split Mixture of shell shards as exposure in the form of hexagon paving, with a total sample = 7 PCs. obtained Shear Strength with the equation: Y= - Ln (X) +55.782 and the correlation R2= 0.9639. So it should be in teaching and learning activities need to be supported with adequate laboratory equipment facilities. Considering that Polytechnic graduates are prepared to become ready-to-use staff, they need to be supported by various skills. Specifically, majors in civil engineering include being able to operate related workshop equipment. laboratory testing equipment. One of the several tests in the building materials laboratory is the Shear Strength test so that on this occasion a Multi-function Shear Strength Test tool will be created so that students can not only imagine it from the instructor, but need to understand and be skilled in operating the Shear Strength testing equipment as a provision for work later Keywords: Creating Multi-function Shear Strength Test Equipment, Research, learning.

Keywords:- *Multifunctional Shear Strength Test Tool, Research and Service, Learning.*

I. INTRODUCTION

Inspired by the Shear Strength Test Equipment in the Laboratory of Building Materials, Department of Civil Engineering, Polytechnic. That's all, especially the shear strength of wood, with samples that do not comply with the Test Standards using manual equipment. Even though the Civil Polines Department has modern equipment, namely the Yu Lie UTM Machine with a capacity of 30 KN. And Computer. Which is not used as it should be for improving the quality and quality of Polines students.

The results of the Ministry of Manpower and JICA (Japan International Cooperation Agency) studies in 1996 as well as the Need Level Study, the quality and relevance of Polines tertiary graduates in industry, conducted by PII (Indonesian Engineers Association) with the Higher Education in 2000 illustrate that the main aspects considered by the industry in hiring new employees graduating from Technical Colleges are: Attitude (38), Work experience/skill (27%), Knowledge (23%), Quality of school (10%), Good recommendation (2%). It is hoped that this developing issue will become a whip for managers of the academic community to always evaluate performance in all sectors, both at the input, output process and outcome stages. As a consequence, the preparation of prospective experts who are skilled and professional and respond to issues that develop into real needs in winning the above global competition. The role of the Polytechnic as a provider of vocational professional education is very precise and strategic in responding to and responding to the enactment of the Construction Services Law, demands in the global era and other developing external issues. The global era at the ASEAN Free Trade Area (AFTA) level which began in 1993 has had a positive impact on individuals who have quality and global insight. Opportunities, opportunities and job competition are getting sharper and tighter. Skilled and professional workers from ASEAN will freely enter the labor market in Indonesia. While the Indonesian workforce, according to the party, is still unable to compete, compared to fellow countries in ASEAN. On the other hand, the enactment of Law no. 18/1999 concerning Construction Services that, both domestic and foreign workers must have job skills/expertise certification issued by institutions, associations and colleges.

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In the last 5 years, polytechnic education majoring in civil engineering has implemented a curriculum that applies nationally in accordance with Ministerial Decree No: 76/U/1997, then revised with Ministerial Decree No: 232/U/2000, which came into force starting in the 2006/2006 school year. 2007. As a follow-up to the Ministerial Decree, the government gave universities the freedom to develop their curricula according to the competencies of graduates, so that they could formulate which stressing competencies would be emphasized. Whether conceptual competence, technical competence, integrative competence, adaptive competence, interpersonal competence or all will be accommodated according to the proportions in the professional context. The main basis for competency development is built from three aspects of needs, namely: community needs, professional needs and industrial needs. This competency is the pillar of curriculum development so that the Vision and Mission of the Civil Engineering Department can be approached. The curriculum at the Polytechnic is structured in a distinctive manner that still refers to the identity of the Polytechnic, namely by prioritizing a balance between knowledge and skills with a proportion of 50% theory and 50% practice (laboratory practice, workshop practice, field practice and classroom practice with intensive guidance) as well as discipline. as the spearhead of education providers (Ahmadi and Supriyadi, 2003). With regard to practical skills in the laboratory, teaching and learning activities should be supported by adequate laboratory equipment facilities. Considering that Polytechnic graduates are prepared to become ready-to-use staff, they need to be supported by various skills in accordance with the majors they study. Specifically for civil engineering majors, they are able to operate Building Materials Laboratory equipment, especially the Multifunctional Shear Strength Test Equipment, which is related to practice, as well as testing equipment in the laboratory. One of several tests in the building materials laboratory is the shear strength test for wood, mortar, concrete, and building materials such as paving, brick, bricks, etc. There is no tool for testing building materials in the laboratory, so on this occasion we created a Multifunctional Shear Testing Tool, so students can not only imagine or receive explanations from instructors, but need to understand and be skilled at operating Multifunctional shear strength testing equipment because it is a provision for work later graduate.

While the research to be carried out is the design of a multifunctional shear strength test equipment. The conclusions in previous research regarding the design of simple shear strength test equipment, has several weaknesses including manual load readings and the possibility of data deviation and satisfaction from customers, and unstable data acquisition, this will affect the load reading results obtained . The design of the multifunctional shear strength test tool was made by developing existing Yie tools, while the propulsion machine was used. The Yie LI UTM machine was equipped with a computerized hydraulic tool so that it was hoped that it could be used for multi-functional shear strength testing, bearing in mind that the computerized shear strength test was 30 Kn. Another benefit of this tool is that it can be used for testing local wood in an effort to utilize and empower the potential of the region for such construction materials.

II. FORMULATION OF THE PROBLEM

Formulation of the problem to get different opportunities in the era of globalization Polines students need adequate skills provision, including practical skills and testing in the laboratory. While the equipment in the laboratory does not exist, so it needs to be cultivated. Creating a multifunctional shear strength test tool is a development and refinement of the previous test tool so that now it is computerized and refers to the ASTM D-143-52 shear strength test. Based on the existing problems, it can be formulated: What is the design of the Multifunctional Shear Strength testing tool, so that it can be used to support learning activities in the laboratory? This tool is equipped with a test object holder tool. This tool is also the addition of a new tool for testing in the laboratory. This research is to make a Multifunctional Shear Strength Test Tool that can be well-directed, this needs to limit the problem to: 1) Research locations in making Multi-Functional Shear Strength Test Equipment in Steel Workshops and testing of tools in the Building Materials laboratory in the Polines Civil Engineering Department. 2) Assembly of components and parts of tools on the Polines Campus. 3) Preparation of test objects/samples of various paving mixtures in polines. 4) Testing the Multifunctional Shear Strength Test Tool until it functions properly.

A. Research Purposes

Research on Creating a Multifunctional Shear Test Equipment has the following objectives: 1) Making a Multi-Functional Shear Test Tool, to find out the Shear Strength of All Materials, in order to obtain Perfect Shear Strength Data to Support Research and community service and Learning in Polines Laboratories. 2) Can be used for testing all building materials in polines laboratories. 3) Adding new tools to the Civil Engineering Polines laboratory so that it is very helpful in the Research and Service process, as well as teaching and learning at the Polytechnic. 4) Cooperation between construction industries is expected to be able to understand the problems that exist in the field.

B. Benefits of research

From the results of creating a Multi-Functional Shear Test Tool, it is hoped that it will be useful in the development of science and technology. Particularly on Equipment and Shear Strength Data from Building Materials in Indonesia.

III. RESEARCH METHODS

A. Reinforced concrete

Reinforced concrete is a logical combination of two types of materials, namely plain concrete which has high compressive strength but low tensile strength, and steel bars embedded in the concrete which can provide the required tensile strength. (Wang, C.K. and Salmon, 1985).

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B. Definition of Wood

Timber is a forest product from natural sources of wealth, it is also a raw material that is easily processed to be made into goods in accordance with technological advances. The definition of wood here is a material that is obtained from the results of harvesting trees in the forest, which are part of the tree, and it is calculated which part can be used more for a specific purpose. Likewise, sawdust is a type of wood particle with a size of 0.25–2.00 mm, very light weight when dry and easily blown away by the wind. (J.F Dumanau, 1990).

C. Beam Shear Strength

Shear spans in concrete beams without shear reinforcement occur in an area along approximately three times the effective depth of the beam. Cracks due to diagonal tension are one of the causes of shear damage. For shorter shear spans, damage will occur as a combination of shearing, crushing and splitting. Whereas for unreinforced concrete beams with longer shear spans, cracks due to bending tensile stress will occur first before cracks due to diagonal tension occur. Thus the occurrence of bending tension cracks in beams without reinforcement is an early warning of shear damage (Dipohusodo, 1996).

IV. RESULTS AND DISCUSSION

Based on the functional limitations and working methods of the Multifunctional Shear Strength Test Equipment, the basic design of this Multifunctional Shear Strength Test Equipment is made with the basic requirements of materials which include: strong, concise, simple and easy to operate.

A. Design of Multifunctional Shear Strength Test Equipment

The main parts of this equipment consist of: 1) Base under. 2) Elbows Support. 3) Vise Place of the Sample. 4) Elbows - fixed sliding retaining elbows. 5) Friction anvil and sample guide.

B. Functions of Main Parts

Lower runway. The foundation serves as a seat for the initial pressing components and the hydraulic reinforcement system, so the requirements for the foundation are strong, rigid and stable because in its function the foundation must be able to withstand all the forces that occur. The base is made of ST.37 steel in the form of an L elbow 60x60x60 with a length of 350 mm and a width of 180 mm. The framework is made using electric welding joints and bolts.

Support pillar. The support pillars function to hold the base of the vise and support other components of the entire equipment so that they remain in place during and after the testing process takes place. The support pillars are tied. Lower base plate and upper base by means of fastening bolt nuts. Given its very important function, the supporting pillars are made using S 45 C steel, L60x60X 100 elbows.

Auxiliary tool for test stand for multi-function shear strength in the form of vise. The stand for the shear strength test of wood is made of 20 mm thick steel plate with ST 37 steel quality, this is intended so that the construction is able to withstand the forces during the wood shear test process.

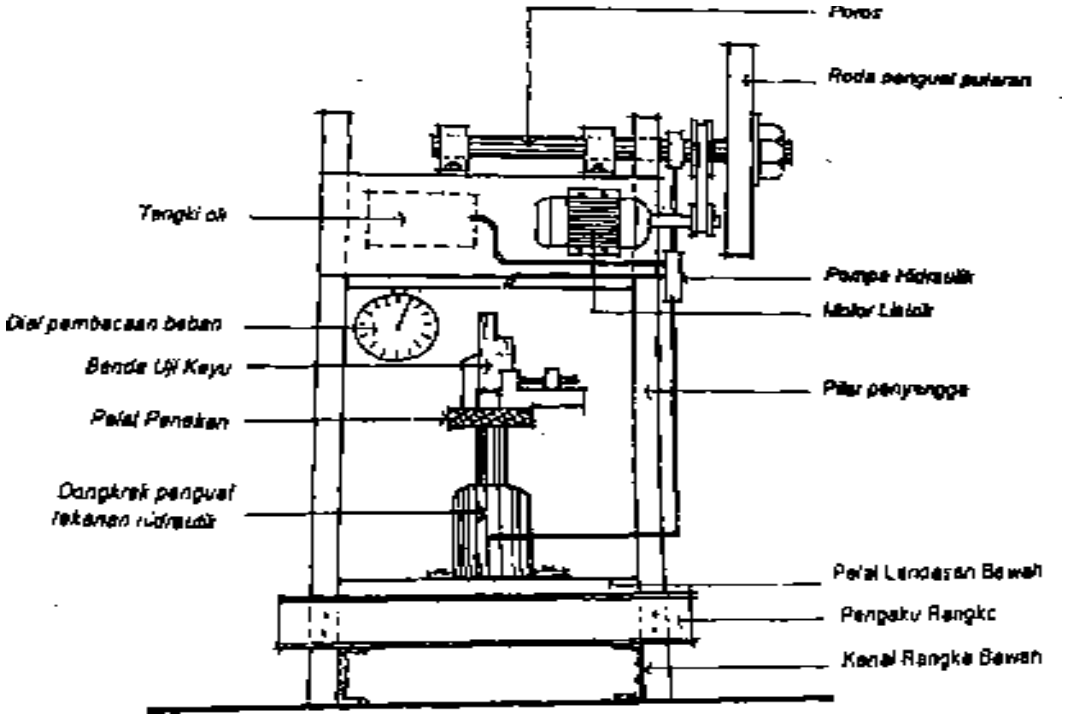

Fig. 1: Multifunctional Shear Strength Tester

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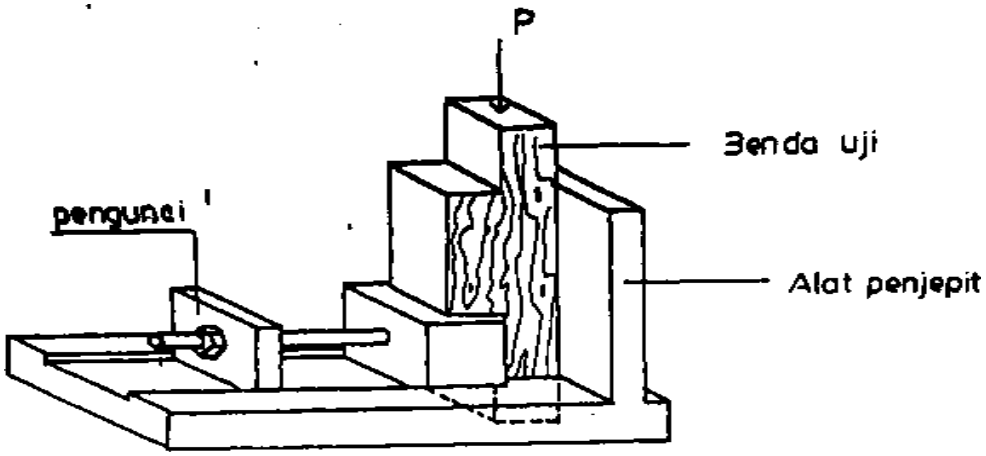

Fig. 2: Mounting tool / Toll Jig Test Sample

C. Main Pressing Section

The main pressing part is an ordinary hydraulic jack which is commonly used in car jacks. The jack capacity is 3 tons and it is easy to get on the market, considering that this jack has a relatively small physical size of 0.75mm and a maximum height of 350mm, the overall size of the wood shear test equipment is not that big.

D. Hydraulic Pressure Booster Section

The hydraulic pressure booster device functions to increase the initial pressure provided by an ordinary hydraulic jack so that the large shear force requirements can be met. Basically, this hydraulic pressure booster utilizes a hydraulic system that works using the principle of Pascal's law, namely the continuation of pressure in all directions and is the same when an incompressible fluid is under pressure. While the definition of pressure is a force acting on a working area. In a simple formula the above statement can be written as follows:

$$P=F/A$$

Where:
P = Pressure (N/mm²) F = Force (N)
A = Working area (mm²).

The application of Pascal's law can be described schematically as follows:

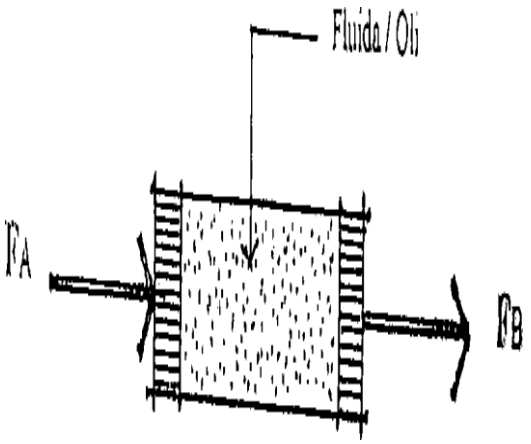

Fig. 3: Schematic of Pascal's Law Diagram

The force F in field A will be forwarded to field B by the fluid/oil in the tube. Because the area of tube A and the area of tube B are the same, the FA force and FB force are the same, because the pressure P in plane A will be transmitted in all directions and the same amount by the fluid/oil. (As per Pascal's Law). If it is desired that the FB force be greater than the FA force, the area of the B field must be enlarged as shown in the following schematic image:

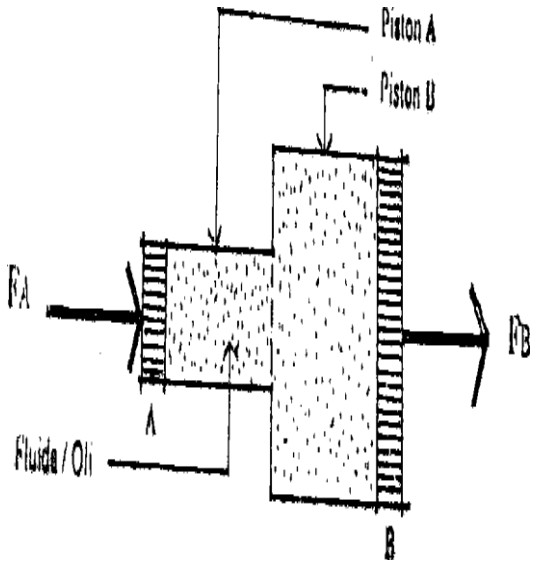

Fig. 4: Schematic diagram of hydraulic compression

The area of piston B is much larger than the area of piston A, so:

P= F / A
PA = PB
FA/AA = FB / AB
FB = FA / AA X AB

Because the area of piston B is made much larger than the area of piston A as the initial force receiving area, there will be an amplification of the FB force several times greater than the incoming force and in accordance with the comparison between the two areas (Satito, 2003).

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E. Multifunctional Shear Tester Design

The design of the Multifunctional Shear Test Equipment that will be made from this research includes:

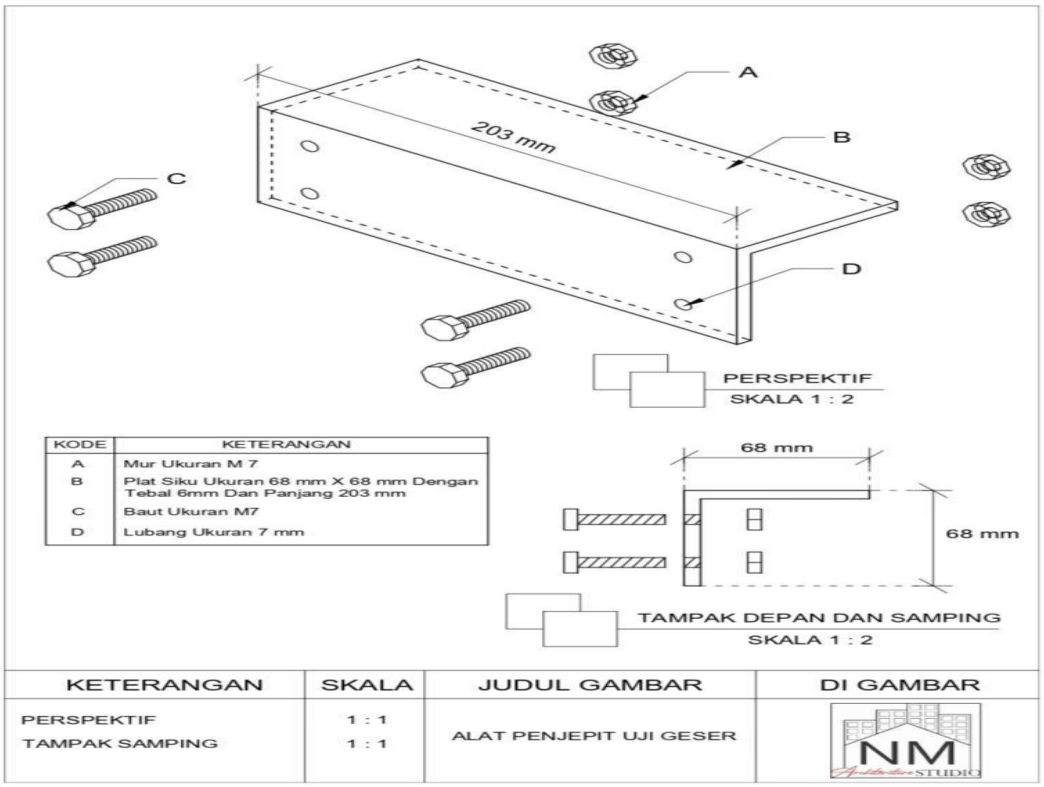

Fig. 5: Design of a multifunctional shear test clamp in front and side view

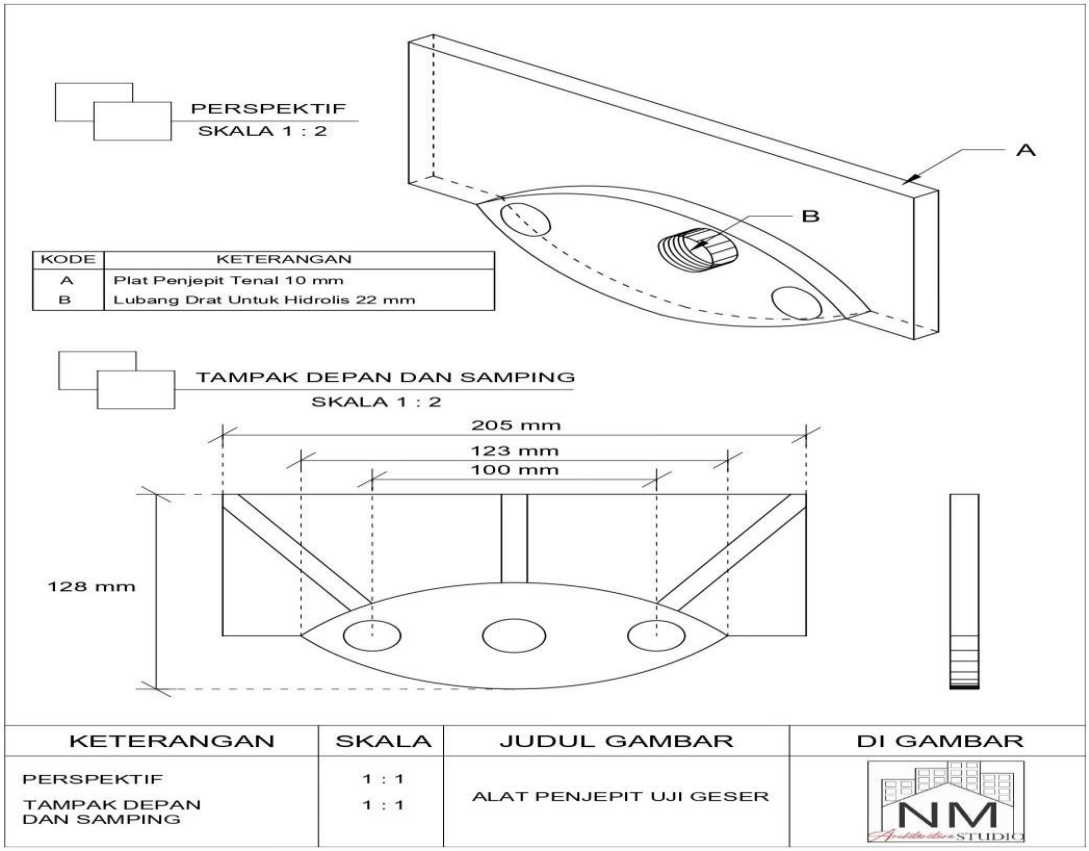

Fig. 6: Design of the multi-function shear test clamp, front and side views

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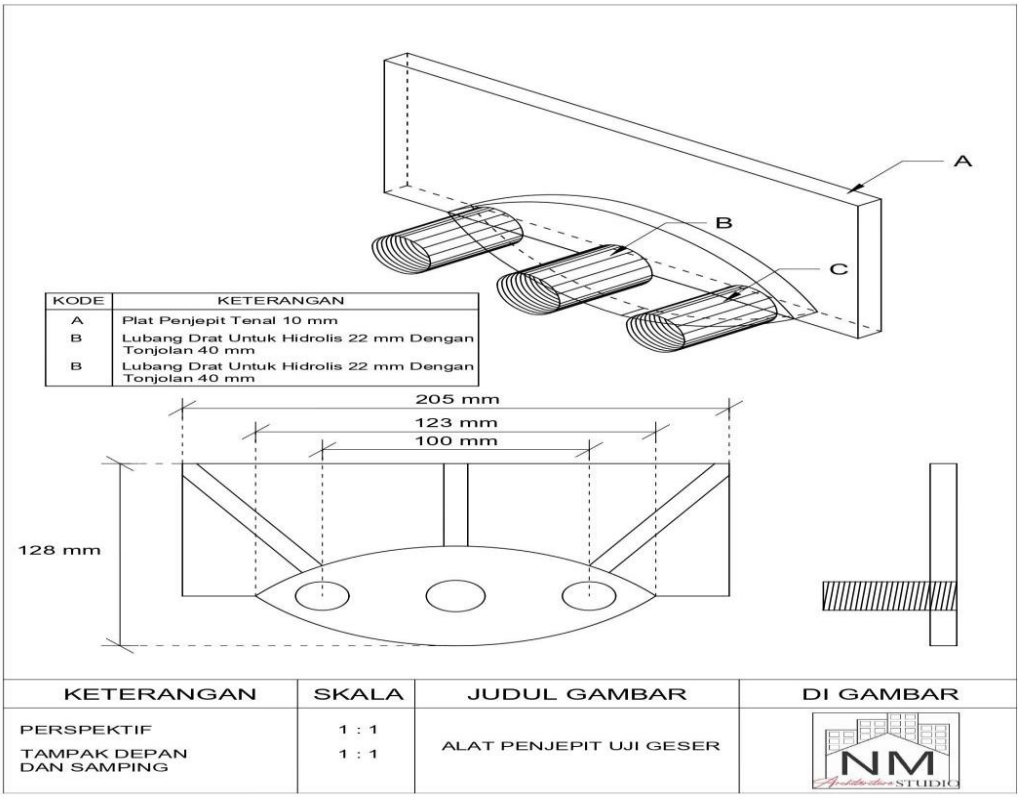

Fig. 7: Design of a 1:1 scale multifunction shear test clamp

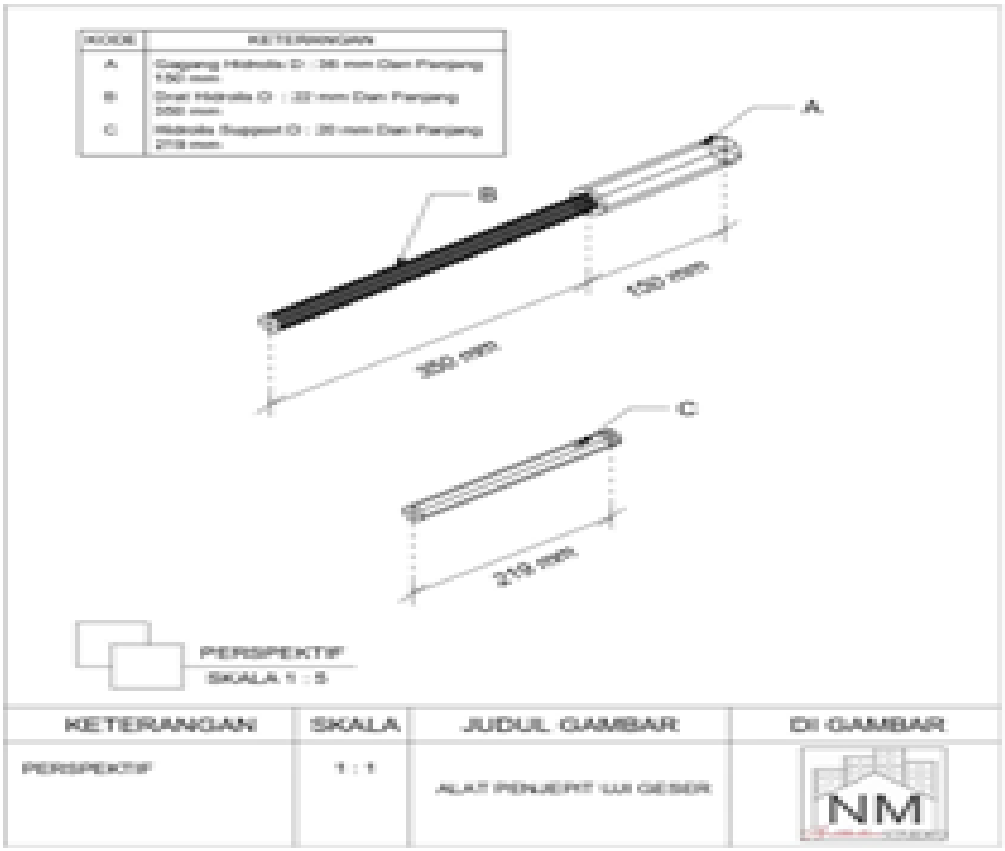

Fig. 8: Thread design of the 1:1 scale Multifunctional shear test clamp tool

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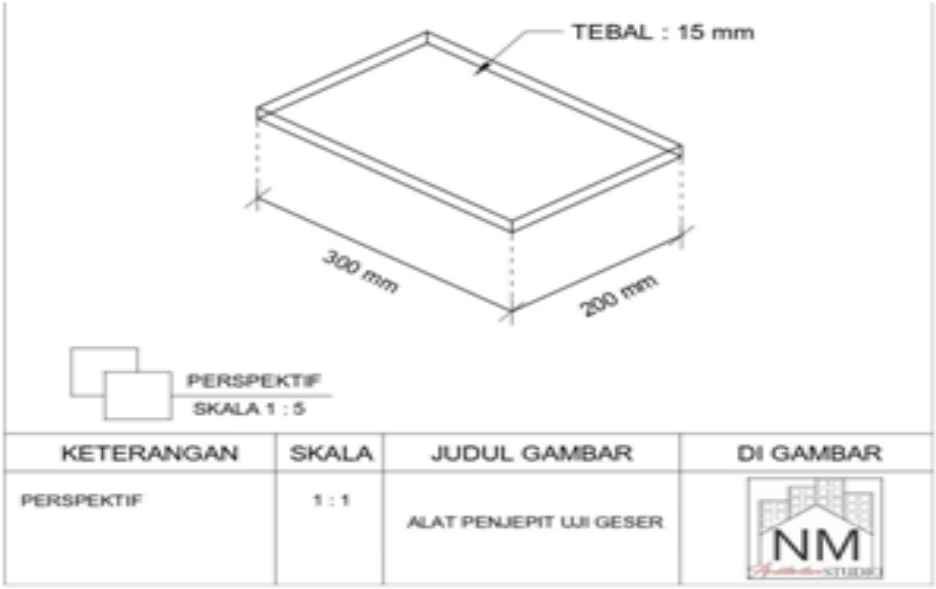

Fig. 9: Design of a 1:5 scale multifunction shear test tool

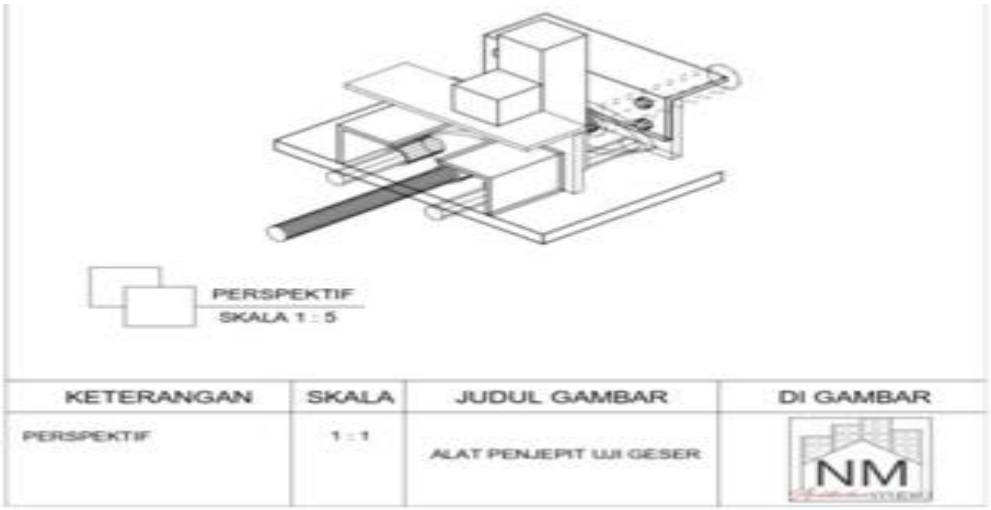

Fig. 10: Design of a 1:5 scale multifunction shear tester

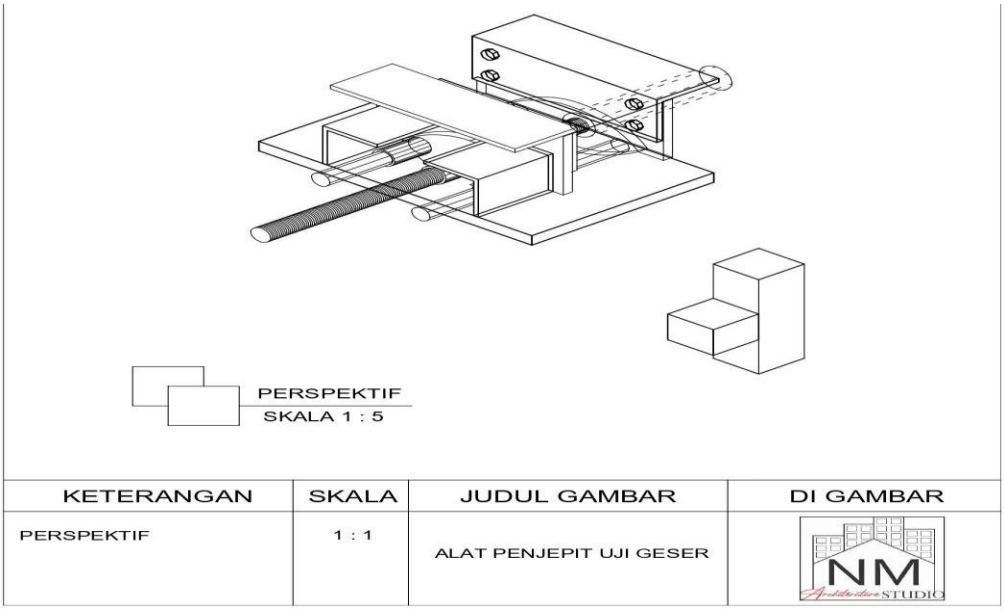

Fig. 11: Design of a 1:5 scale shear test clamp

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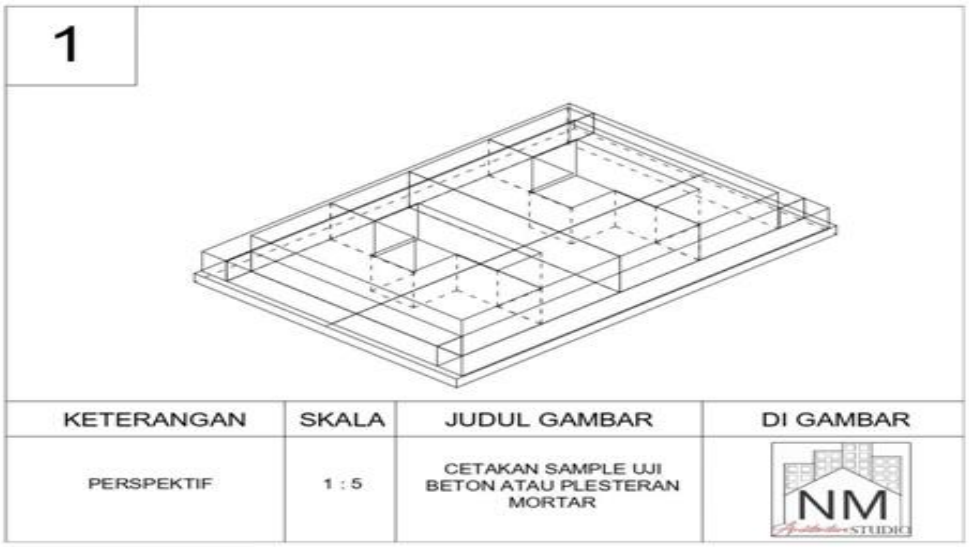

Fig. 12: Concrete test sample prints with a scale of 1:5

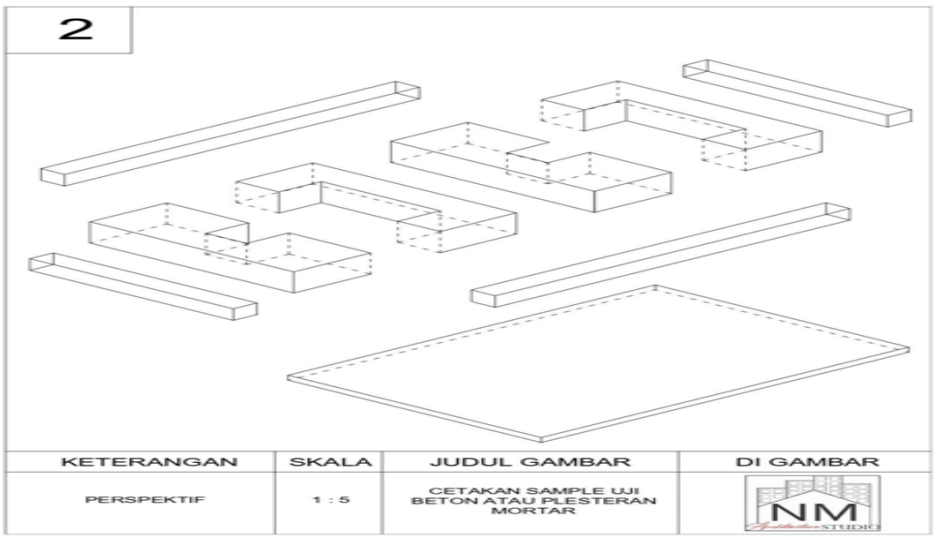

Fig. 13: 1:5 scale concrete test sample prints

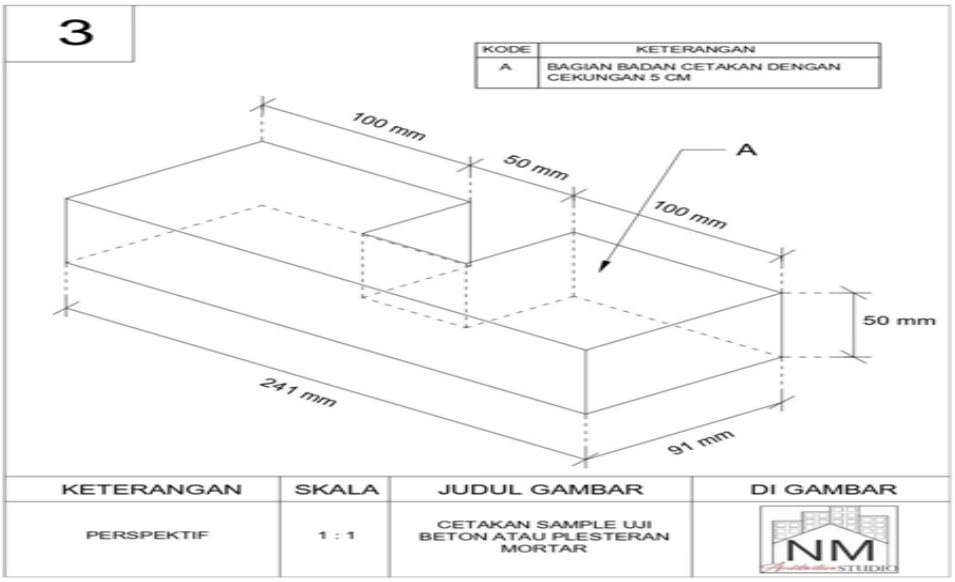

Fig. 14: 1:1 scale concrete test sample prints

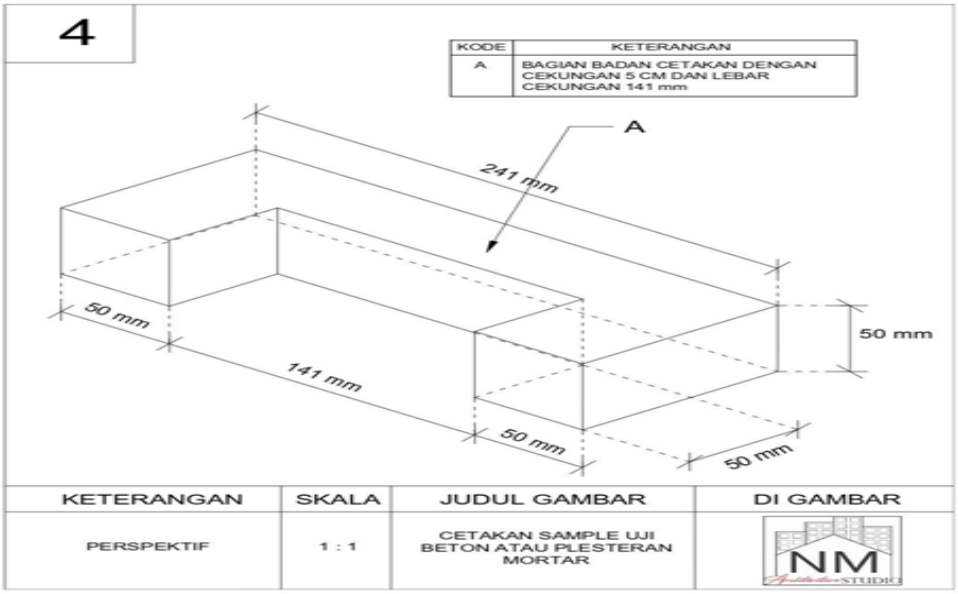

Fig. 15: 1:1 scale concrete test sample prints

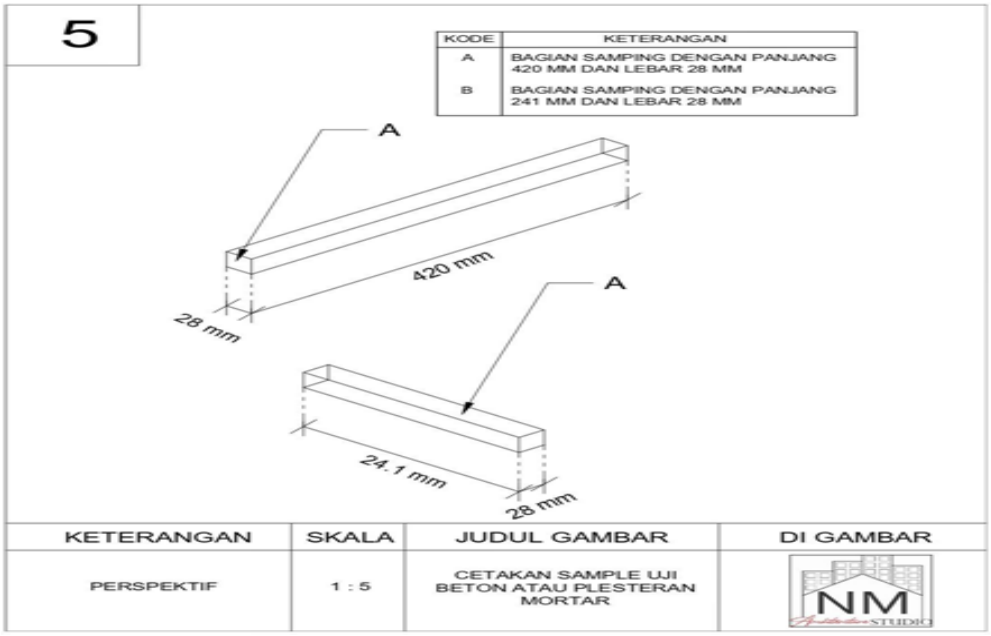

Fig. 16: Prints of concrete test samples with a scale of 1:5

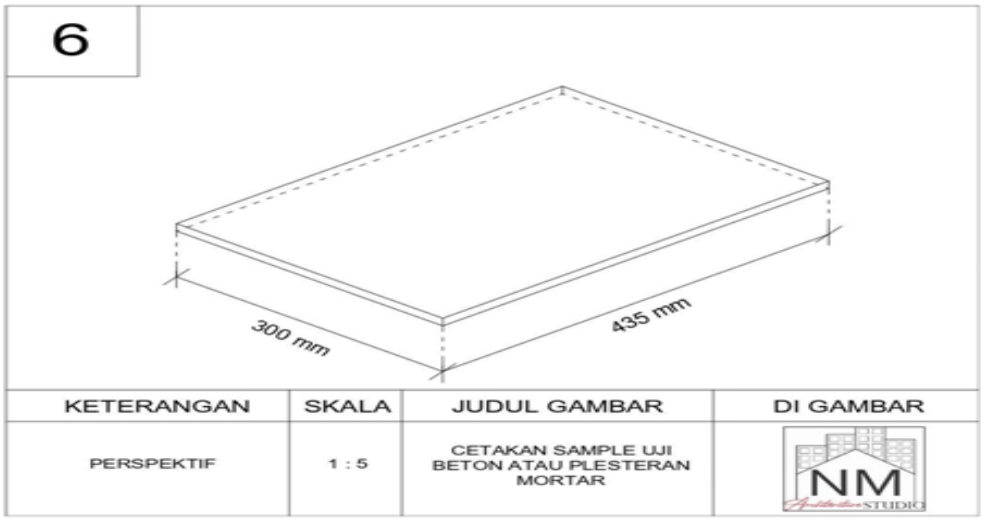

Fig. 17: Concrete test sample prints with a scale of 1:5

F. Test Procedure of the Multifunctional Shear Tester

The Trial Procedure of the Multifunctional Shear Test Equipment includes:

- Preparation of the Multi Function Shear Test tool on a 30 KN UTM machine.
- Preparation of specimens to be tested for Shear Strength at Laboratory Locations.
- Place the Shear test object on the Multifunctional Shear tester in the proper position.
- Position the YU LIE UTM machine on the Multi-function shear test tool and perpendicular to the test sample.
- Run the Yu lie UTM Machine. In the process of pressing.
- After the Slide Test Process is Complete, Print the Results on the Printer.
- Then it is repeated until all samples are finished.
- Clean the UTM machine and test sample tray.
- Turn off the UTM Machine.

G. Result

Based on the results of the analysis and discussion, the following conclusions can be drawn:

H. UTM Machine Test Results.

UJI GESER MORTAR SEGI 6
PTUP. TJOKRO HADI, SST., MT

SampleID	MORTAR SEGI 6_1	TestDate	10/6/2022
Operator	TJOKRO HADI	Type	Flat
Size(mm)	60.6*56.5	So(mm²)	3423.90
Lo(mm)	0	Fbc(kN)	16.60
Rbc(MPa)	5	Fsc(kN)	/
Rsc(MPa)	/	Fpc(kN)	8.34
Rpc(MPa)	0	Ftc(kN)	/
Rtc(MPa)	/	Ec(GPa)	0.09

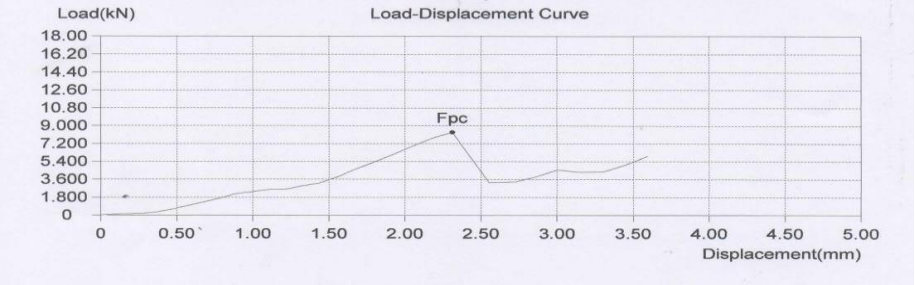

Fig. 18: 6-sided mortar shear test

UJI GESER MORTAR SEGI 6
PTUP. TJOKRO HADI, SST., MT

SampleID	MORTAR SEGI 6_2	TestDate	10/6/2022
Operator	TJOKRO HADI	Type	Flat
Size(mm)	64*50.4	So(mm²)	3225.60
Lo(mm)	0	Fbc(kN)	11.42
Rbc(MPa)	5	Fsc(kN)	/
Rsc(MPa)	/	Fpc(kN)	11.16
Rpc(MPa)	5	Ftc(kN)	/
Rtc(MPa)	/	Ec(GPa)	0.08

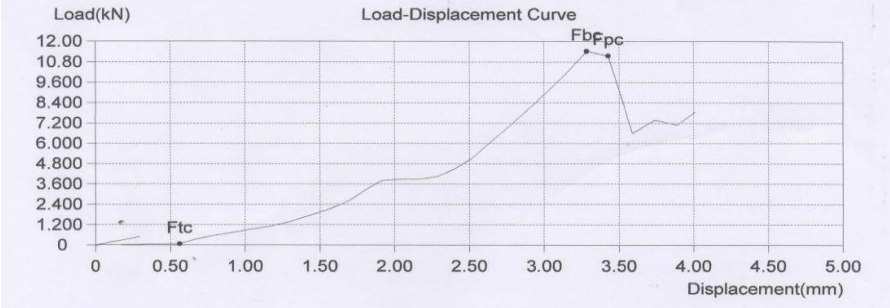

Fig. 19: 6-sided mortar shear test

UJI GESER MORTAR SEGI 6
PTUP. TJOKRO HADI, SST., MT

SampleID	MORTAR SEGI 6_3	TestDate	10/6/2022
Operator	TJOKRO HADI	Type	Flat
Size(mm)	61.8*55	So(mm²)	3399.00
Lo(mm)	0	Fbc(kN)	22.68
Rbc(MPa)	5	Fsc(kN)	/
Rsc(MPa)	/	Fpc(kN)	22.68
Rpc(MPa)	5	Ftc(kN)	15.91
Rtc(MPa)	5	Ec(GPa)	0.16

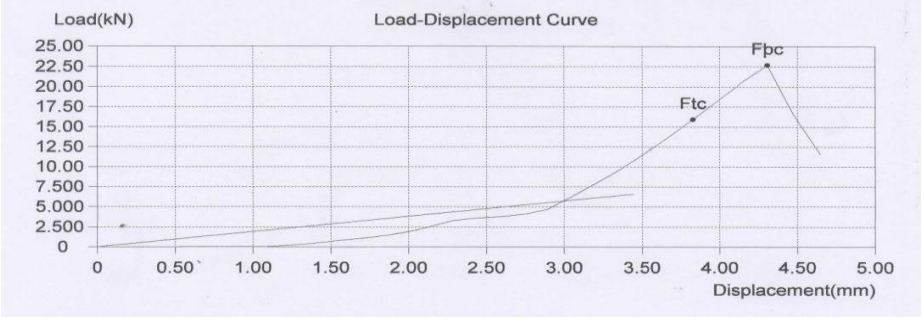

Fig. 20: 6-sided mortar shear test

UJI GESER MORTAR SEGI 6
PTUP. TJOKRO HADI, SST., MT

SampleID	MORTAR SEGI 6_4	TestDate	10/6/2022
Operator	TJOKRO HADI	Type	Flat
Size(mm)	60.1*49.5	So(mm²)	2974.95
Lo(mm)	0	Fbc(kN)	20.79
Rbc(MPa)	5	Fsc(kN)	16.28
Rsc(MPa)	5	Fpc(kN)	18.29
Rpc(MPa)	5	Ftc(kN)	/
Rtc(MPa)	/	Ec(GPa)	0.18

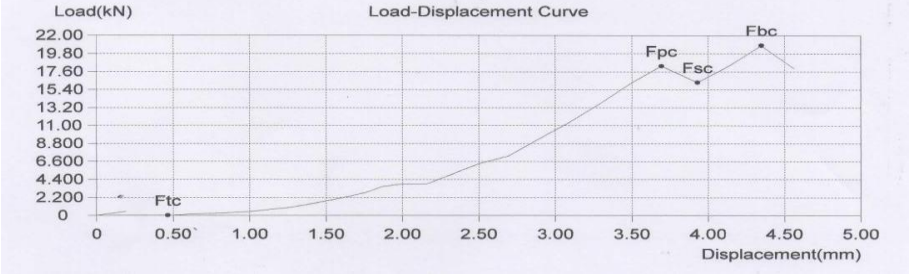

Fig. 21: 6-sided mortar shear test

UJI GESER MORTAR SEGI 6
PTUP. TJOKRO HADI, SST., MT

SampleID	MORTAR SEGI 6_5	TestDate	10/6/2022
Operator	TJOKRO HADI	Type	Flat
Size(mm)	62*48	So(mm²)	2976.00
Lo(mm)	0	Fbc(kN)	11.01
Rbc(MPa)	5	Fsc(kN)	/
Rsc(MPa)	/	Fpc(kN)	5.69
Rpc(MPa)	0	Ftc(kN)	5.36
Rtc(MPa)	0	Ec(GPa)	0.08

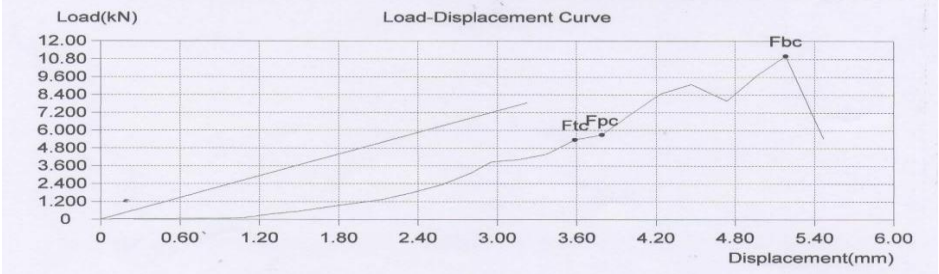

Fig. 22: 6-sided mortar shear test

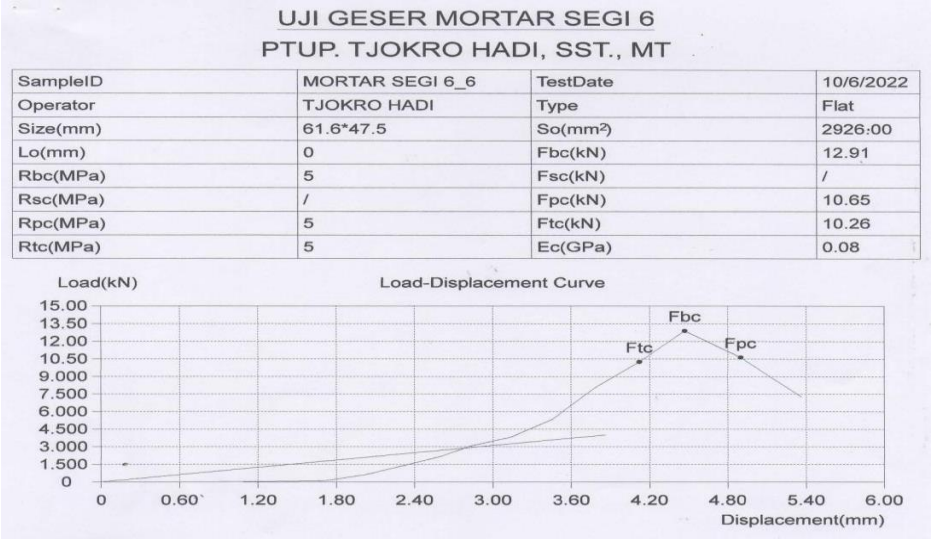

Fig. 23: 6-sided mortar shear test

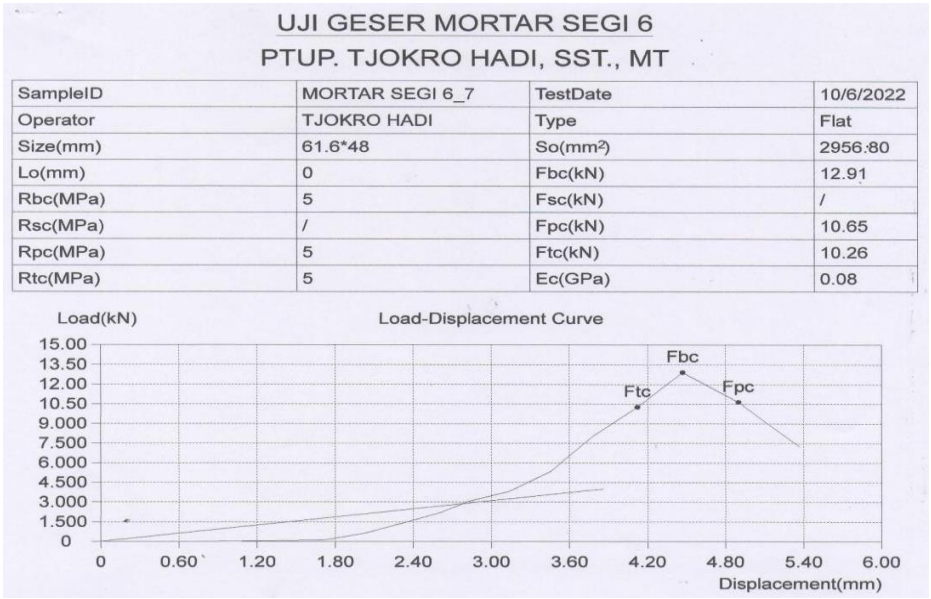

Fig. 24: 6-sided mortar shear test

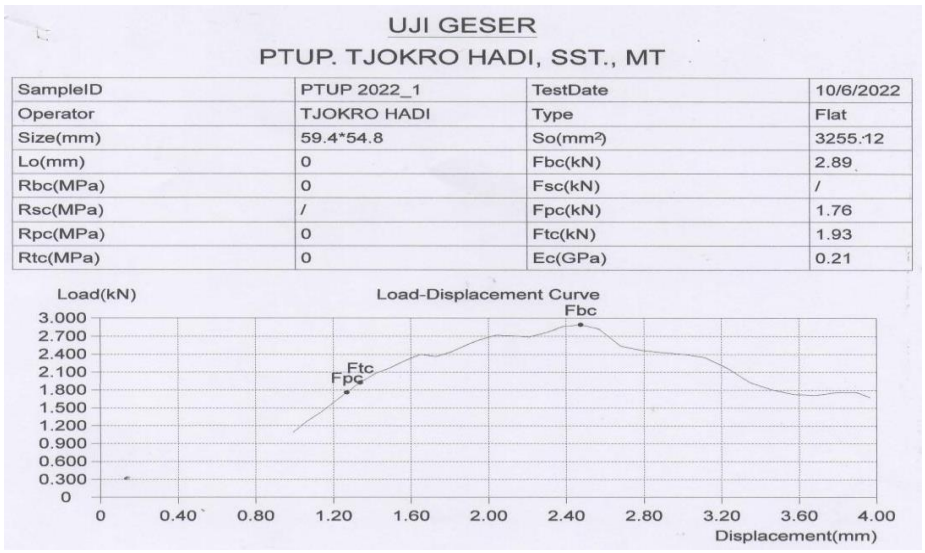

Fig. 25: 4-sided mortar shear test

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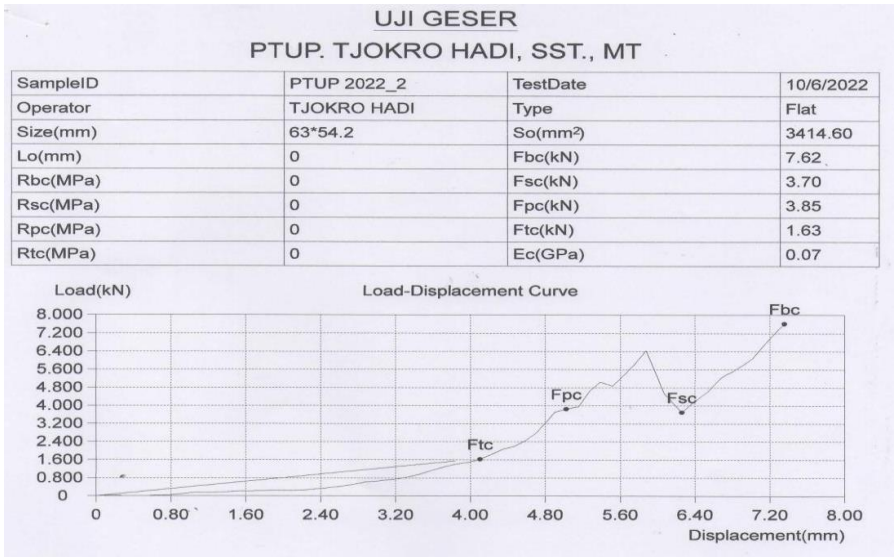
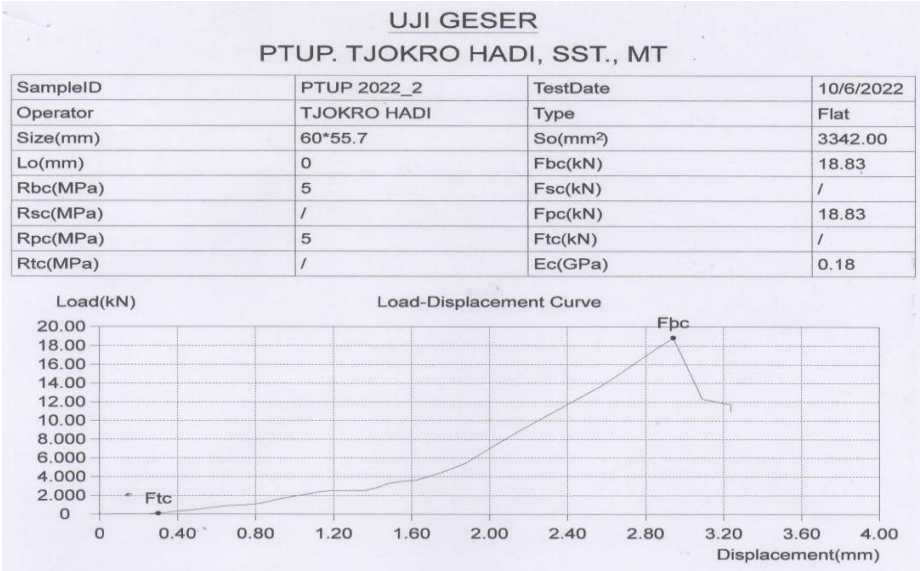

UJI GESER
PTUP. TJOKRO HADI, SST., MT

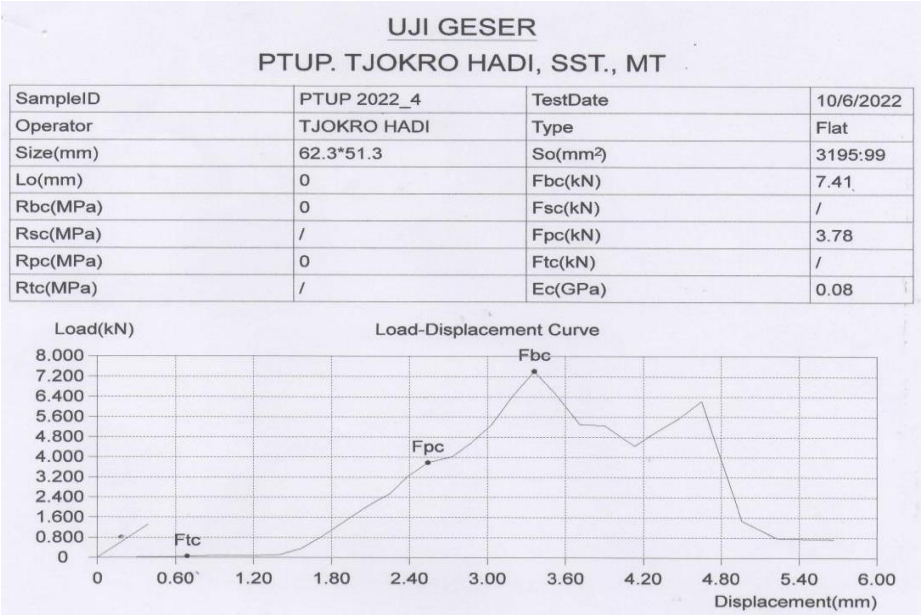
SampleID	PTUP 2022_2	TestDate	10/6/2022
Operator	TJOKRO HADI	Type	Flat
Size(mm)	63*54.2	So(mm²)	3414.60
Lo(mm)	0	Fbc(kN)	7.62
Rbc(MPa)	0	Fsc(kN)	3.70
Rsc(MPa)	0	Fpc(kN)	3.85
Rpc(MPa)	0	Ftc(kN)	1.63
Rtc(MPa)	0	Ec(GPa)	0.07

Fig. 26: 4-sided mortar shear test


UJI GESER
PTUP. TJOKRO HADI, SST., MT

SampleID	PTUP 2022_2	TestDate	10/6/2022
Operator	TJOKRO HADI	Type	Flat
Size(mm)	60*55.7	So(mm²)	3342.00
Lo(mm)	0	Fbc(kN)	18.83
Rbc(MPa)	5	Fsc(kN)	/
Rsc(MPa)	/	Fpc(kN)	18.83
Rpc(MPa)	5	Ftc(kN)	/
Rtc(MPa)	/	Ec(GPa)	0.18

Fig. 27: 4-sided mortar shear test


UJI GESER
PTUP. TJOKRO HADI, SST., MT

SampleID	PTUP 2022_4	TestDate	10/6/2022
Operator	TJOKRO HADI	Type	Flat
Size(mm)	62.3*51.3	So(mm²)	3195:99
Lo(mm)	0	Fbc(kN)	7.41
Rbc(MPa)	0	Fsc(kN)	/
Rsc(MPa)	/	Fpc(kN)	3.78
Rpc(MPa)	0	Ftc(kN)	/
Rtc(MPa)	/	Ec(GPa)	0.08

Fig. 28: 4-sided mortar shear test

UJI GESER
PTUP. TJOKRO HADI, SST., MT

SampleID	PTUP 2022_5	TestDate	10/6/2022
Operator	TJOKRO HADI	Type	Flat
Size(mm)	59*53.4	So(mm²)	3150.60
Lo(mm)	0	Fbc(kN)	10.56
Rbc(MPa)	5	Fsc(kN)	/
Rsc(MPa)	/	Fpc(kN)	9.15
Rpc(MPa)	5	Ftc(kN)	0.73
Rtc(MPa)	0	Ec(GPa)	0.07

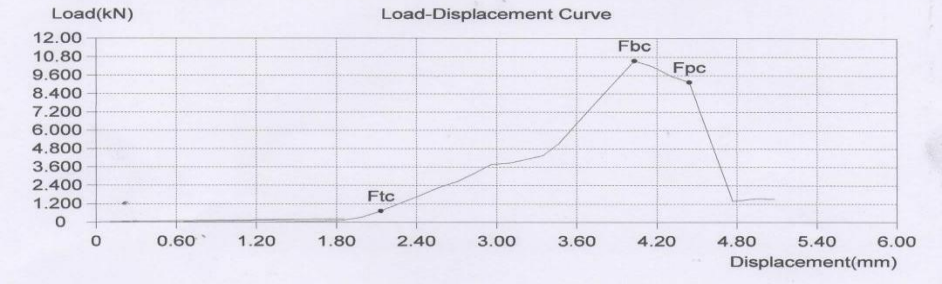


Fig. 29: 4-sided mortar shear test

UJI GESER
PTUP. TJOKRO HADI, SST., MT

SampleID	PTUP 2022_6	TestDate	10/6/2022
Operator	TJOKRO HADI	Type	Flat
Size(mm)	62.8*49.9	So(mm²)	3133.72
Lo(mm)	0	Fbc(kN)	9.30
Rbc(MPa)	5	Fsc(kN)	7.86
Rsc(MPa)	5	Fpc(kN)	7.86
Rpc(MPa)	5	Ftc(kN)	6.20
Rtc(MPa)	0	Ec(GPa)	0.05

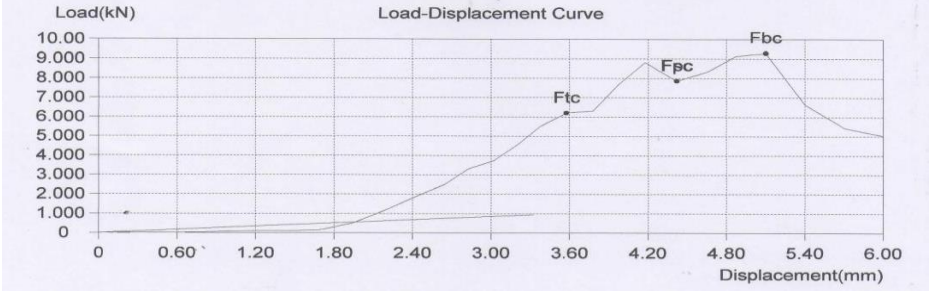


Fig. 30: 4-sided mortar shear test

UJI GESER
PTUP. TJOKRO HADI, SST., MT

SampleID	PTUP 2022_7	TestDate	10/6/2022
Operator	TJOKRO HADI	Type	Flat
Size(mm)	63.4*54.6	So(mm²)	3461.64
Lo(mm)	0	Fbc(kN)	3.87
Rbc(MPa)	0	Fsc(kN)	/
Rsc(MPa)	/	Fpc(kN)	3.64
Rpc(MPa)	0	Ftc(kN)	/
Rtc(MPa)	/	Ec(GPa)	0.04

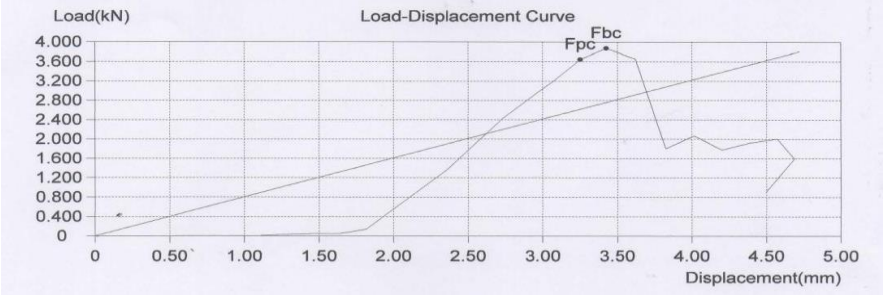


Fig. 31: 4-sided mortar shear test

UJI GESER
PTUP. TJOKRO HADI, SST., MT

SampleID	PTUP 2022_8	TestDate	10/6/2022
Operator	TJOKRO HADI	Type	Flat
Size(mm)	60.3*55.4	So(mm²)	3340:62
Lo(mm)	0	Fbc(kN)	11.97
Rbc(MPa)	5	Fsc(kN)	/
Rsc(MPa)	/	Fpc(kN)	11.97
Rpc(MPa)	5	Ftc(kN)	/
Rtc(MPa)	/	Ec(GPa)	0.14

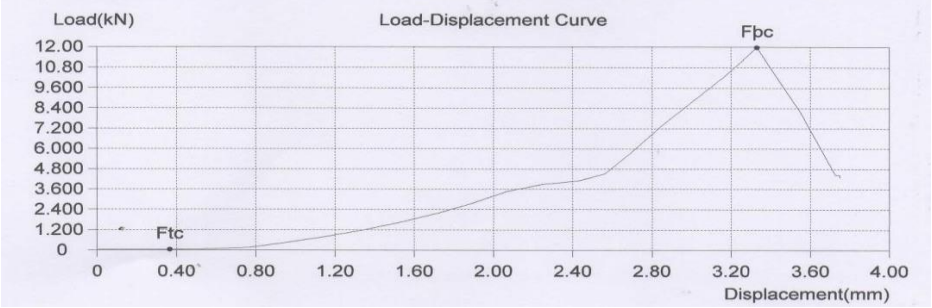


Fig. 32: 4-sided mortar shear test

UJI GESER
PTUP. TJOKRO HADI, SST., MT

SampleID	PTUP 2022_9	TestDate	10/6/2022
Operator	TJOKRO HADI	Type	Flat
Size(mm)	60.2*55.3	So(mm²)	3329.06
Lo(mm)	0	Fbc(kN)	10.79
Rbc(MPa)	5	Fsc(kN)	/
Rsc(MPa)	/	Fpc(kN)	10.79
Rpc(MPa)	5	Ftc(kN)	/
Rtc(MPa)	/	Ec(GPa)	0.08

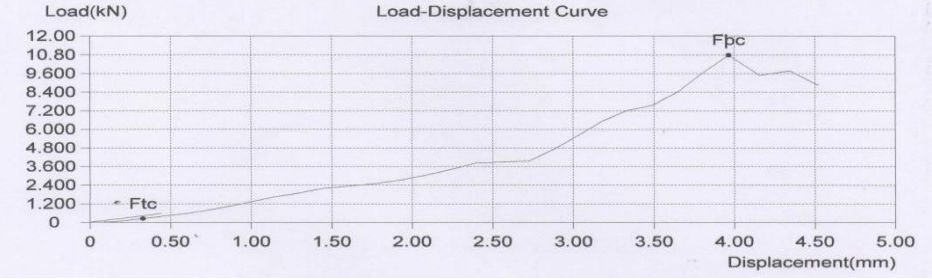


Fig. 33: 4-sided mortar shear test

UJI GESER
PTUP. TJOKRO HADI, SST., MT

SampleID	PTUP 2022_10	TestDate	10/6/2022
Operator	TJOKRO HADI	Type	Flat
Size(mm)	59.1*53	So(mm²)	3132.30
Lo(mm)	0	Fbc(kN)	4.61
Rbc(MPa)	0	Fsc(kN)	/
Rsc(MPa)	/	Fpc(kN)	1.98
Rpc(MPa)	0	Ftc(kN)	1.15
Rtc(MPa)	0	Ec(GPa)	0.05

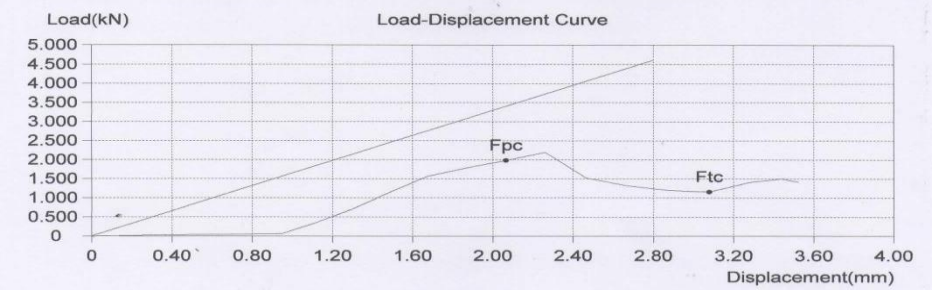


Fig. 34: 4-sided mortar shear test

UJI GESER
PTUP. TJOKRO HADI, SST., MT

SampleID	PTUP 2022_11	TestDate	10/6/2022
Operator	TJOKRO HADI	Type	Flat
Size(mm)	58.3*54.4	So(mm²)	3171.52
Lo(mm)	0	Fbc(kN)	21.87
Rbc(MPa)	5	Fsc(kN)	11.33
Rsc(MPa)	5	Fpc(kN)	11.69
Rpc(MPa)	5	Ftc(kN)	8.15
Rtc(MPa)	5	Ec(GPa)	0.19

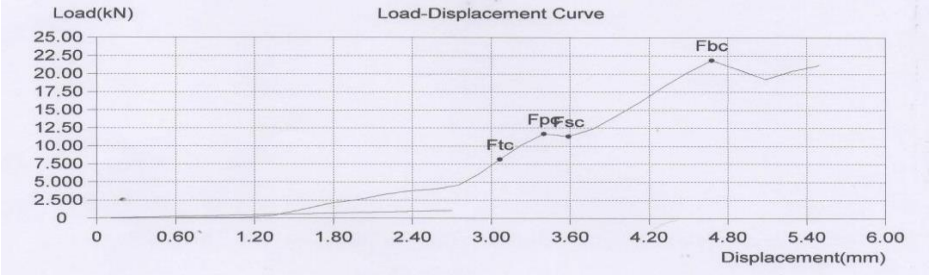


Fig. 35: 4-sided mortar shear test

UJI GESER
PTUP. TJOKRO HADI, SST., MT

SampleID	PTUP 2022_12	TestDate	10/6/2022
Operator	TJOKRO HADI	Type	Flat
Size(mm)	58.3*54.5	So(mm²)	3177.35
Lo(mm)	0	Fbc(kN)	21.87
Rbc(MPa)	5	Fsc(kN)	11.33
Rsc(MPa)	5	Fpc(kN)	11.69
Rpc(MPa)	5	Ftc(kN)	8.15
Rtc(MPa)	5	Ec(GPa)	0.19

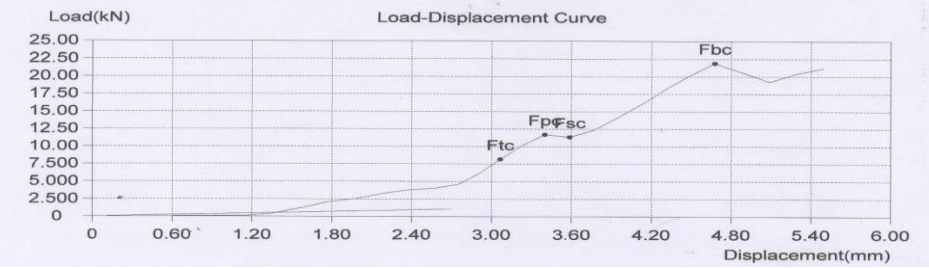


Fig. 36: 4-sided mortar shear test

I. Tools Made

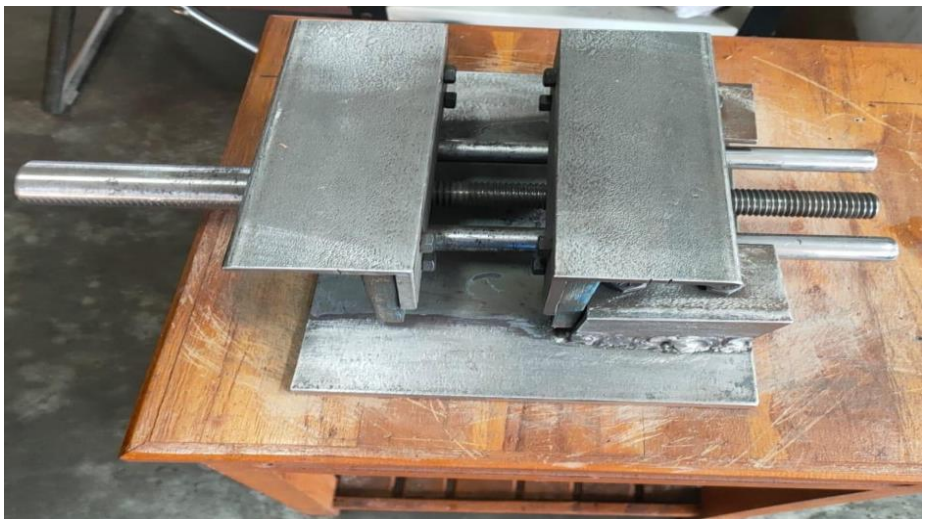


Photo 1: top view of tools

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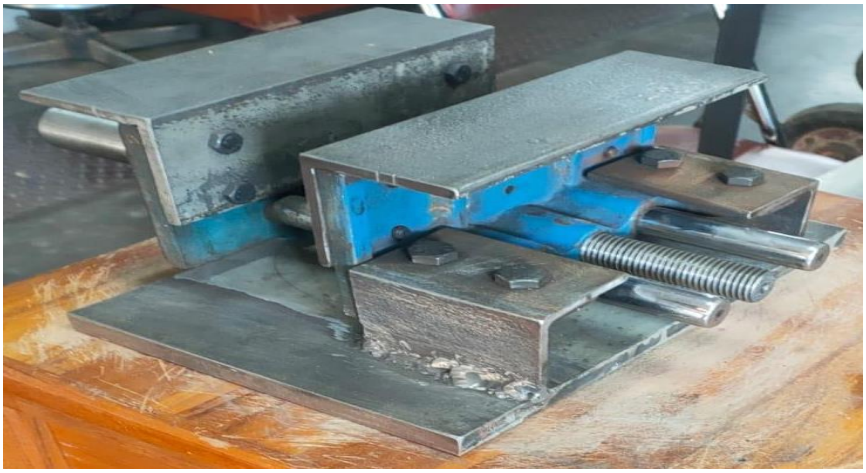

Photo 2: tool made side view

Photo 3: Item to be tested

J. Data Analysis Of Test Results From Machines

Table 1: Analysis of the data from the results of the hexagon mortar shear test from the machine

Politeknik Negeri Semarang
Lab. Bahan, Teknik Sipil
Jl. Prof. Soedarto, Tembalang Semarang

UJI GESER MORTAR SEGI ENAM

No	P	L	A	Fac	berat	τ	
	cm	cm	cm 2	kN	gr	kN	Teg geser
3	6.180	5.500	33.990	18.830	1423.360	0.554	56.490
5	6.200	4.800	29.760	10.560	1263.860	0.355	36.183
6	6.160	4.750	29.260	9.300	1199.920	0.318	32.410
4	6.010	4.950	29.750	7.410	1313.970	0.249	25.399
2	6.4	5.04	32.256	7.62	1237.42	0.236	24.089
6	6.16	4.75	29.26	9.3	1199.92	0.318	13.346
1	6.06	5.65	34.239	2.89	1277.15	0.084	8.606948

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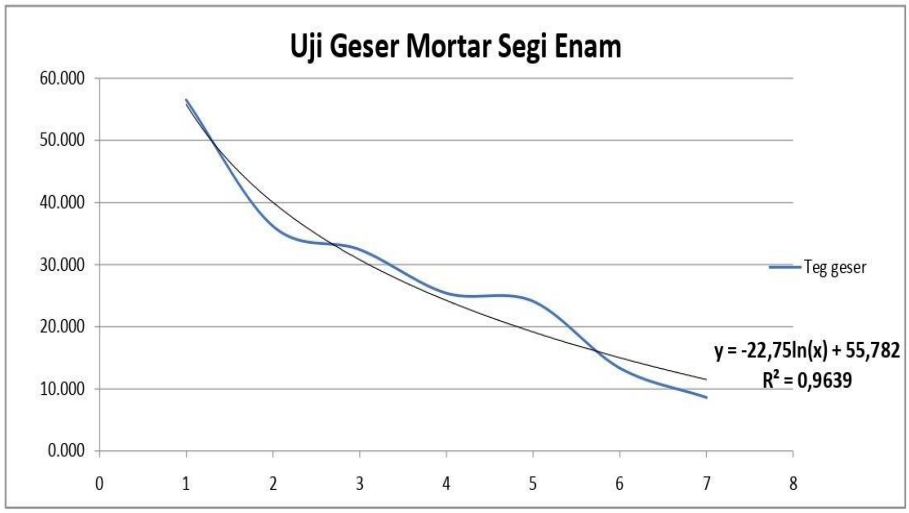


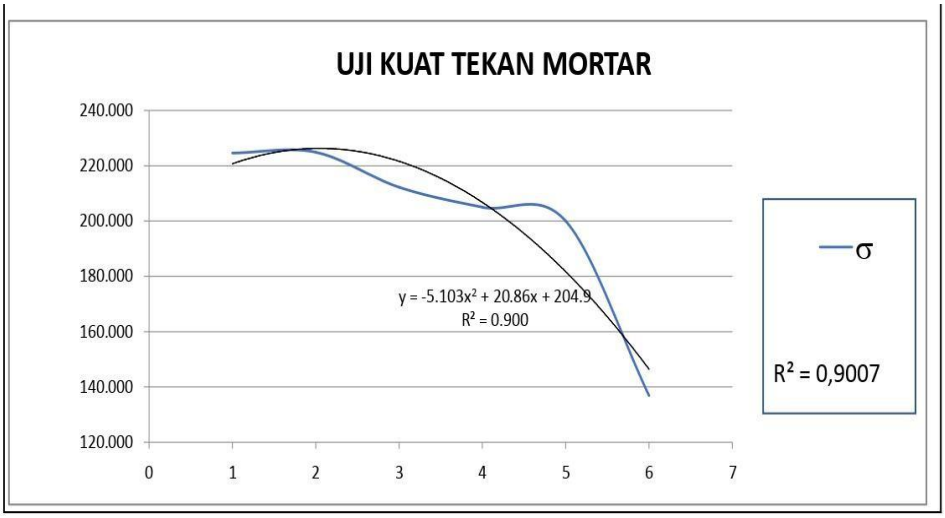
Graph 1: Data analysis from the results of the hexagon mortar shear test from the machine

Table 2: Analysis of data from the compressive strength test results of the hexagon mortar from the machine

Politeknik Negeri Semarang
Lab. Bahan, Teknik Sipil
Jl. Prof. Soedarto, Tembalang Semarang

UJI KUAT TEKAN MORTAR

No	Fbc (P)	A	σ	
	KN	Cm2	KN/.....Kg/Cm	σ
1	67.36	30.5809	2.203	224.607
2	67.45	30.5809	2.206	224.908
3	63.64	30.5809	2.081	212.203
4	61.48	30.5809	2.010	205.001
5	59.98	30.5809	1.961	199.999
6	41.08	30.5809	1.343	136.979



Graph 2: Analysis of data from the results of the hexagon mortar compressive strength test from the machine

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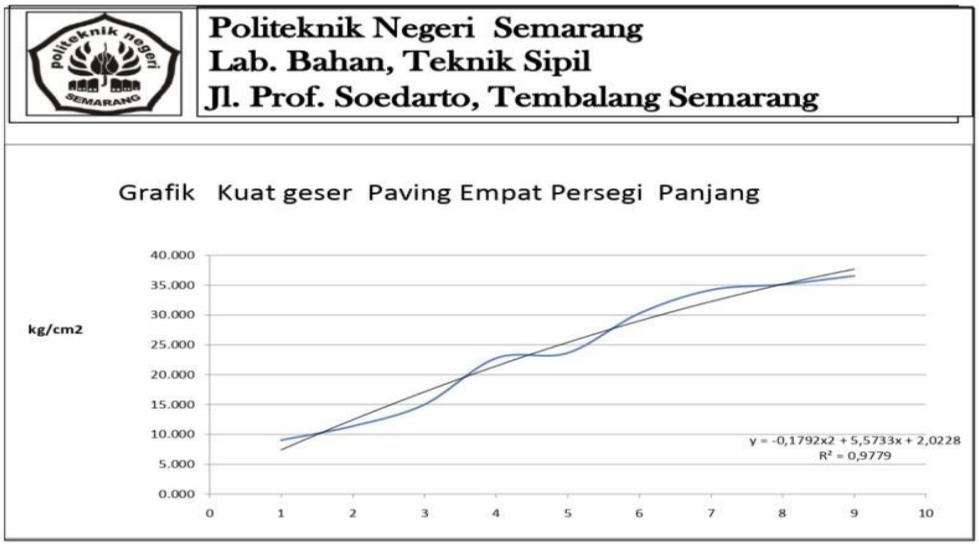
Table 3: Of data analysis from the results of the compressive strength test of rectangular mortar from the machine

Politeknik Negeri Semarang
Lab. Bahan, Teknik Sipil
Jl. Prof. Soedarto, Tembalang Semarang

No	P	L	A	Fac	berat	KUAT GESER	
	cm	cm	cm 2	kN	gr	kN	kg/cm2
1	5.94	5.48	32.5512	2.89	1277.15	0.089	9.053
2	6.34	5.46	34.6164	3.87	1252.92	0.112	11.400
3	5.91	5.3	31.323	4.61	1116.08	0.147	15.008
4	6.3	5.42	34.146	7.62	1237.42	0.223	22.756
5	6.23	5.13	31.9599	7.41	1313.97	0.232	23.642
6	6.28	4.99	31.3372	9.3	1199.92	0.297	30.262
7	5.9	5.34	31.506	10.56	1263.86	0.335	34.178
8	5.914	5.3	31.3442	10.79	1275.16	0.344	35.102
9	6.03	5.54	33.4062	11.97	1433.99	0.358	36.538



Graph 3: Analysis of the data from the shear strength test results of the rectangular mortar of the machine

K. Testing Photo

Photo 4: The team shows the object to be tested

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Photo 5: The team prepares objects to be tested with test equipment

Photo 6: Team members preparing and setting tools to test objects

Photo 7: The team shows the object after being tested

L. Discussion

In the trial process of the multifunctional shear strength test equipment/running multifunctional shear strength test equipment, the test objects are rectangular paving and hexagonal paving.

Mixed Mortar 1 PC: 5 PS, in the form of rectangular Paving material formed into a Test Sample with a total of 12 PC samples. And in implementation it failed so that the number of samples = 9 PCs. , from the results of the Test Execution, Shear Strength with the equation Y = - 0.1792 X2 + 5.5733 X + 2.0228 and its correlation R2 = 0.9779.

And 1 PC Mortar mixture: 4PS + Split Mixture of shell shards as exposure in the form of hexagon paving, with a total sample = 7 PCs. shear strength is obtained by the equation: Y =- Ln (X) +55.782 and the correlation R2 = 0.9639.

V. CONCLUSION

After modifying the tool by redesigning it, it is necessary to run the tool by testing the test sample/shear test object to obtain accurate data results of 12 pieces for rectangular paving and 7 hexagon paving test objects and tools Multifunctional shear test in Good - good / Normal conditions, with the meaning of the conclusion of the Multifunctional Shear Strength Test Tool Strong, simple and easy to function.

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